REMARKS

Reconsideration and allowance are respectfully requested in light of the above amendments and the following remarks.

Applicants acknowledge with appreciation the indication in the Office Action that claims 2, 4-6, 8-10, and 12 contain allowable subject matter and would be allowed if amended to overcome the rejection under 35 USC 112, second paragraph.

Additionally, Applicants wish to thank the Examiner and her supervisor for the courtesy extended to their representative during the personal interview conducted on April 2, 2003. The issues discussed during the interview are summarized in the following paragraphs.

A new Abstract is submitted herewith as required by the Office Action.

The disclosure has been objected to, according to the Office Action, because reference characters 24 and 27 are identified in the specification but not in the drawings. However, these reference characters are illustrated in original Fig. 3.

Claims 1-4, 7, 8, 11, and 12 have been amended solely to clarify the claims and thereby overcome the rejections under 35 USC §112, second paragraph. These amendments are considered to be non-narrowing, and no estoppel should be deemed to attach thereto.

Claims 1 and 13 stand rejected under 35 USC §103(a) as being unpatentable over Ueda et al. (US 6,418,108). Claims 3, 7, 11, and 14-16 stand rejected under 35 USC §103(a) as being unpatentable over Kim et al. (US 6,337,841) in view of Arai et al. (US 6,411,587). Applicants respectfully traverse these rejections.

Claim 1 now recites:

> *An optical pickup apparatus for recording or reproducing information on or from an optical disc, said apparatus comprising:*
>
> *a light source radiating a laser beam;*
>
> *an optical detector detecting a reflected light from the optical disc;*
>
> *a collimator lens converting the radiated light of said light source into a fine divergent pencil of rays; and*
>
> *an objective lens that focuses said rays on said optical disc, wherein*
>
> *said collimator lens has a surface that is curved to form a wavefront shape that increasingly corrects a coma aberration of the radiated light in correspondence to a radial distance between a center of the collimator lens and a position at which said radiated light intersects said collimator lens.*

Ueda fails to disclose the claimed features whereby a surface of the collimator lens is curved to form a wavefront shape that increasingly corrects a coma aberration of the radiated light in correspondence to a radial distance between the center of the collimator lens and a position at which the radiated light intersects the collimator lens.

The Office Action states that U da discloses in Fig. 1 a collimator that forms a wave shap that corrects a coma aberration (Office Action, page 3, penultimate paragraph). The portions of Ueda cited by the Office Action for providing this disclosure are col. 5, lines 35-66, col. 6, lines 5-30, and col. 26, lines 30-44 (Office Action, page 3, penultimate paragraph).

However, Ueda does not disclose or suggest a collimator that forms a wave shape for correcting a coma aberration. Instead, Ueda discloses that the coma aberration is generated by the radial tilt of an optical disc 2 and is increased in proportion to the third power of the numerical aperture (NA) of an objective lens 16 (col. 12, lines 29-32). Thus, as the numerical aperture of objective lens 16 increases, it becomes more crucial to suppress the coma aberration (col. 12, lines 32-34).

Ueda discloses that the coma aberration is suppressed by reducing the thickness t of a light transmitting layer 4 of optical disc 2 (col. 12, lines 35-36). Also, Ueda discloses that a satisfactory coma aberration is achieved for a DVD when thickness t satisfies the relation $t \leq 0.1296/NA^3$ (col. 12, lines 36-41).

Moreover, Ueda discloses that the optical systems of the disclosed examples 1 and 2 are less susceptible to the effects of coma aberration due to the small numerical aperture on the light

inlet side of the collimator lens (col. 26, lines 35-39). Ueda states that the nominal amount of tilt experienced by the optical system raises no problem since the amount of coma aberration generated by this tilt is small (col. 26, lines 39-43).

In accordance with the above discussion, the Applicants submit that Ueda fails to disclose or suggest all of Applicants' claimed features and fails to teach or suggest the benefits accruing from them. More specifically, Ueda fails to disclose or teach the claimed features whereby a surface of the collimator lens is curved to form a wavefront shape that increasingly corrects a coma aberration of the radiated light in correspondence to a radial distance between a center of the collimator lens and a position at which the radiated light intersects the collimator lens. Therefore, allowance of claim 1 and all claims dependent therefrom is warranted.

Independent claim 3 now recites:

> *An optical pickup apparatus for recording or reproducing information on or from an optical disc, said apparatus comprising:*
>
> *a first light source radiating a laser beam having a first wavelength;*
>
> *a first detector detecting reflected light from the optical disc;*
>
> *a second light source radiating a laser beam having a second wavelength longer than said first wavelength;*
>
> *a second detector detecting reflected light from the optical disc;*

a light separator introducing the laser beam having said first wavelength and the laser beam having said second wavelength to the substantially same optical axis;

an objective lens functioning so as to form a smaller spot from the laser beam having said first wavelength than from the laser beam having said second wavelength;

a first collimator lens converting the radiated light of said first light source into a substantially parallel beam; and

a second collimator lens converting the radiated light of said second light source into a fine divergent pencil of rays, wherein:

said second collimator lens has a surface that is curved to form a wavefront shape that increasingly corrects a coma aberration of the radiated light of said second light source in correspondence to a radial distance between a center of the second collimator lens and a position at which the radiated light of said second light source intersects said second collimator lens.

Kim and Arai fail to disclose or suggest the claimed features whereby: (1) a second collimator lens converts the radiated light of the second light source into a fine divergent pencil of rays and (2) a surface of the second collimator lens is curved to form a wavefront shape that increasingly corrects a coma aberration of the radiated light of the second light source in correspondence to a radial distance between a center of the second collimator lens and a position at which the radiated light of the second light source intersects the second collimator lens.

The Office Action states that Kim discloses a second collimator 225 that forms a wave front shape forming a fine divergent light (Office Action, page 4, penultimat paragraph). However, Kim does not disclose or suggest that collimator 225

forms a fine divergent light. Instead, Kim states that a second optical unit 220 may further compris a second collimator lens 225 for condensing the incident emanated light into parallel light (col. 9, lines 38-41). Kim discloses the opposite functionality for second collimator lens 225 to that proposed in the Office Action, and the above-cited portion of Kim provides the entire disclosure regarding second collimator 225.

As acknowledged in the Office Action, Kim does not disclose correcting a coma aberration (Office Action, page 4, penultimate paragraph). The Office Action cites Arai for providing this disclosure. Specifically, the Office Action states that Arai discloses an optical pickup system having a collimator lens 13/130 that corrects a coma aberration (Office Action, page 4, last paragraph).

With regard to reference character 13, Arai discloses in Fig. 1 a diffraction-integral type collimator 13 that converts a divergent light flux emitted from a semiconductor laser 11 into a collimated light flux that is parallel with an optical axis (col. 28, lines 13-16). As is the case with Kim, Arai also discloses a collimator that converts divergent light into a collimated light flux that is parallel with an optical axis. Therefore, Arai discloses the opposite functionality for collimator 13 to that proposed in the Office Action.

With regard to collimator 130, Arai discloses in Fig. 21 that a light flux emitted from a first semiconductor laser 111 is transmitted through beam splitter 230 and collimator 130, which forms the light into a collimated light flux (col. 45, lines 27-33). Also, Arai discloses that a laser beam from a second semiconductor laser 112 enters collimator 130 obliquely, from the collimator's optical axis, and is converted into collimated light (col. 46, lines 23-28). As is the case for collimator 13, Arai discloses the opposite functionality for collimator 130 to that proposed in the Office Action.

Citing col. 41, lines 48-67, of Arai, the Office Action states that Arai discloses an optical pick-up system for spherical and coma aberration correction where collimator lens 13/130 is configured to correct coma aberration (Office Action page 4, last paragraph). The Office Action states that the collimator, which has a grating surface, is positioned to convert the radiated light into fine divergent pencil rays and to correct the coma aberration (Office Action page 4, last paragraph).

However, Arai discloses the following in the cited portion of the specification. A diffraction pattern expressed by a polynomial of (X, Y) is provided on the surface of the collimator, which surface is closer to a light source (col. 41, lines 49-51). With this collimator, it is possible to make light

emitt d from either light source emerge from the collimator as light that is parallel with an optical axis, by using: (1) 0-order light for a light source with a wavelength of 650 nm and (2) primary light for a light source with a wavelength of 780 nm that is located away from an optical axis by 0.1 mm (col. 41, lines 51-57). When parallel rays of light, having a wavelength of 780 nm, enter the surface of the collimator that is farther from the light source, a coma is generated with a value of 0.010 λ, in terms of a standard deviation value, on the collimator having the diffraction grating identified in Example 7 (col. 41, lines 57-62). However, the collimator of Example 8 corrects the coma to 0.000 λ using a diffraction pattern expressed by a polynomial of (X, Y), instead of the diffraction grating used in Example 7 (col. 41, lines 62-67).

Arai does not disclose or suggest the claimed feature whereby the collimator converts the radiated light into fine divergent pencil rays, as stated in the Office Action. To the contrary, Arai unequivocally states that the collimator causes the light received from either source to emerge as light that is parallel with the collimator's optical axis.

Moreover, Arai does not disclose or suggest the claimed feature whereby a surface of the collimator lens is curved to form a wavefront shape that increasingly corrects a coma

aberration of the source's radiated light. Instead of a curved surface providing the correction of the coma aberration, Arai discloses that a diffraction pattern or grating provides the correction. The Office Action confirms this interpretation of Arai's teaching by stating that the collimator has a grating that provides the coma aberration correction (Office Action, page 4, last paragraph).

Furthermore, Arai does not disclose or suggest the claimed feature whereby the surface of the collimator lens is formed to increasingly correct the coma aberration in correspondence to a radial distance away from a center of the collimator lens that the light intersects it.

In accordance with the above discussion, Applicants submit that Kim and Arai, considered alone or together, fail to disclose or suggest all of Applicants' claimed features. Specifically, Kim and Arai fail to disclose or suggest the claimed features whereby: (1) a second collimator lens converts the radiated light of the second light source into a fine divergent pencil of rays and (2) a surface of the second collimator lens is curved to form a wavefront shape that increasingly corrects a coma aberration of the radiated light of the second light source in correspondence to a radial distance between a center of the second collimator lens and the position at which the radiated light of the s cond

light source intersects the second collimator lens. Therefore, allowance of claim 3 and all claims dependent therefrom is warranted.

Independent claims 7 and 11 also recite the features discussed above, in connection with the rejection to claim 3. Claims 7 and 11 are similarly rejected based on the combined teachings of Kim and Arai. For at least the same reasons provided in connection with claim 3, claims 7 and 11 are patentably distinguishable over the prior art. Therefore, allowance of claims 7 and 11 and all claims dependent therefrom is warranted.

In view of the above, it is submitted that this application is in condition for allowance and a notice to that effect is respectfully solicited.

If any issues remain which may best be resolved through a telephone communication, the Examiner is requested to telephone the undersigned at the local Washington, D.C. telephone number listed below.

Respectfully submitted,

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--ABSTRACT OF THE DISCLOSURE

An optical recording/reproducing apparatus has a light source that radiates a laser beam, an optical detector that detects reflected light from the optical disc, a collimator lens that converts the radiated light of the light source into a fine divergent pencil of rays, and an objective lens that focuses these rays on the optical disc. The collimator lens has a surface that is curved to form a wavefront shape that increasingly corrects a coma aberration of the radiated light in correspondence to a radial distance between the center of the collimator lens and a position at which the radiated light intersects the collimator lens.--

Exhibit I

IN THE CLAIMS:

Kindly amend the claims as follows.

1. (Amended) An optical pickup apparatus for recording or reproducing [a recording] information [of] on or from an optical disc [or recording the information], said apparatus comprising:

[an optical unit having] a light source radiating a laser beam; [and]

an optical detector detecting [a] reflected light from the optical disc;

a collimator lens converting the radiated light of said light source into a fine divergent pencil of rays; and

an objective lens that focuses said rays on said optical disc, wherein:

[said collimator lens forms a wavefront shape forming a fine divergent light and a wavefront shape correcting a coma aberration, and the wavefront shape correcting said coma aberration is formed in a wavefront shape correcting more coma aberration in correspondence to an increase of radius of said collimator lens]

said collimator lens has a surface that is curved to form a wavefront shape that increasingly corrects a coma aberration of the radiated light in correspondence to a radial distance between

a center of the collimator lens and a position at which said radiated light intersects said collimator lens.

2. (Amended) An optical pickup apparatus as claimed in claim 1, wherein a ratio of sine amount (SIN θ_2/SIN θ_1) between a sine amount (SIN θ_1) of the radiated light from said light source with respect to an optical axis and a sine amount (SIN θ_2) of the light after radiating through said collimator lens with respect to the optical axis increases [substantially] in substantial proportion to a square of said radial distance [radius in correspondence to an increase of radius from a center of said collimator lens].

3. (Amended) An optical pickup apparatus for recording or reproducing [a recording] information [of] on or from an optical disc [or recording the information], said apparatus comprising:

[a first optical unit having]

a first light source radiating a laser beam having a first wavelength, [and]

a first detector detecting [a] reflected light from the optical disc;

[a s cond optical unit having]

a second light source radiating a laser beam having a second wavelength longer than said first wavelength, [and]

a second detector detecting [a] reflected light from the optical disc;

a light [separating means for] separator introducing the laser beam having said first wavelength and the laser beam having said second wavelength to the substantially same optical axis;

an objective lens functioning so as to form a smaller spot [than] from the laser beam having said [second] first wavelength [with respect to] than from the laser beam having said [first] second wavelength;

a first collimator lens converting the radiated light of said first light source into a substantially parallel beam; and

a second collimator lens converting the radiated light of said second light source into a fine divergent pencil of rays, wherein:

[said second collimator lens forms a wavefront shape forming a fine divergent light and a wavefront shape correcting a coma aberration, and the wavefront shape correcting said coma aberration is formed in a wavefront shape correcting more coma aberration in correspondence to an increase of radius of said second collimator lens]

said second collimator lens has a surface that is curved to form a wavefront shape that increasingly corrects a coma aberration of the radiated light of said second light source in correspondence to a radial distance between a center of said second collimator lens and a position at which the radiated light of said second light source intersects said second collimator lens.

4. (Amended) An optical pickup apparatus as claimed in claim 3, wherein a ratio of sine amount (SIN θ_2/SIN θ_1) between a sine amount (SIN θ_1) of the radiated light from said second light source with respect to [an] the optical axis and a sine amount (SIN θ_2) of the light after radiating through said second collimator lens with respect to the optical axis increases [substantially] in substantial proportion to a square of said radial distance [radius in correspondence to an increase of radius from a center of said second collimator lens].

7. (Amended) An optical pickup apparatus for recording or reproducing [a recording] information [of] on or from an optical disc [or recording the information], said apparatus comprising:

[a first optical unit having]

a first light source radiating a laser beam having a first wavelength, [and]

a first detector detecting [a] reflected light from the optical disc;

[a second optical unit having]

a second light source radiating a laser beam having a second wavelength longer than said first wavelength, [and]

a second detector detecting [a] reflected light from the optical disc;

a light [separating means for] separator introducing the laser beam having said first wavelength and the laser beam having said second wavelength to the substantially same optical axis;

an objective lens functioning so as to form a smaller spot [than] from the laser beam having said [second] first wavelength [with respect to] than from the laser beam having said [first] second wavelength;

a first collimator lens converting the radiated light of said first light source into a substantially parallel beam; and

a second collimator lens converting the radiated light of said second light source into a fine divergent pencil of rays, wherein:

[the elements are arranged so that] the radiated light of said second light source forms an optical path reaching said

objective lens through said second collimator lens and said light separating means, and

[said second collimator lens forms a wavefront shape forming a fine divergent light and a wavefront shape correcting a coma aberration, and the wavefront shape correcting said coma aberration is formed in a wavefront shape correcting more coma aberration in correspondence to an increase of radius of said second collimator lens]

said second collimator lens has a surface that is curved to form a wavefront shape that increasingly corrects a coma aberration of the radiated light of said second light source in correspondence to a radial distance between a center of said second collimator lens and a position at which the radiated light of said second light source intersects said second collimator lens.

8. (Amended) An optical pickup apparatus as claimed in claim 7, wherein a ratio of sine amount (SIN θ_2/SIN θ_1) between a sine amount (SIN θ_1) of the radiated light from said second light source with respect to [an] the optical axis and a sine amount (SIN θ_2) of the light after radiating through said second collimator lens with respect to the optical axis increases [substantially] in substantial proportion to a squar of said

radial distance [radius in correspondence to an increas of radius from a cent r of said second collimator lens].

11. (Amended) An optical pickup apparatus for recording or reproducing [a recording] information [of] on or from an optical disc [or recording the information], said apparatus comprising:

[a first optical unit having]

a first light source radiating a laser beam having a first wavelength, [and]

a first detector detecting [a] reflected light from the optical disc;

[a second optical unit having]

a second light source radiating a laser beam having a second wavelength longer than said first wavelength, [and]

a second detector detecting [a] reflected light from the optical disc;

a light [separating means for] separator introducing the laser beam having said first wavelength and the laser beam having said second wavelength to the substantially same optical axis;

an objective lens functioning so as to form a smaller spot [than] from the laser beam having said [second] first wavelength [with respect to] than from the laser beam having said [first] second wav length;

a first collimator lens conv rting the radiated light of said first light source into a substantially parallel beam; and

a second collimator lens converting the radiated light of said second light source into a fine divergent pencil of rays, wherein:

[the elements are arranged so that] the radiated light of said second light source forms an optical path reaching said objective lens through said second collimator lens, said light separating means and said first collimator lens, and

[said second collimator lens forms a wavefront shape forming a fine divergent light and a wavefront shape correcting a coma aberration, and the wavefront shape correcting said coma aberration is formed in a wavefront shape correcting more coma aberration in correspondence to an increase of radius of said second collimator lens]

said second collimator lens a surface that is curved to form a wavefront shape that increasingly corrects a coma aberration of the radiated light of said second light source in correspondence to a radial distance between a center of said second collimator lens and a position at which the radiated light of said second light source intersects said second collimator lens.

12. (Amended) An optical pickup apparatus as claimed in claim 11, wherein a ratio of sine amount (SIN θ_3/SIN θ_1) between a sine amount (SIN θ_1) of the radiated light from said second light source with respect to [an] <u>the</u> optical axis and a sine amount (SIN θ_3) of the radiated light from said second light source after radiating through said first collimator lens with respect to the optical axis increases [substantially] in <u>substantial</u> proportion to a square of said <u>radial distance</u> [radius in correspondence to an increase of radius from a center of said second collimator lens].